

(Confidential - Apple Internal Use Only)

JET PROPULSION LABORATORY

Data Acquisition in Space: Jet Propulsion Lab Relies on Macintosh Technology For Critical Testing

DRAFT: In May 1996, World Wide Web users had a chance to observe the live downlinking of data from an experiment aboard the space shuttle Endeavour. The experiment, called the Brilliant Eyes Ten-Kelvin Sorption Cryocooler Experiment or BETSCE, was designed by the Jet Propulsion Laboratory (JPL) of NASA to test out a new refrigeration technology. This technology, a form of cryocooler called "sorption coolers," was being tested to see whether it could operate in the weightless, vacuum environment of space. Sorption coolers, which can produce temperatures below 10 Kelvin (K) without vibration, will help in future space activities involving precision-pointing astronomy, earth-observation and surveillance space satellite applications.

Challenge: About five years ago, JPL scientists wanted to first test BETSCE in what is called a "proof-of-principle" experiment, an experiment performed on the ground to simulate one best performed in space. Dr. Edmund C. Baroth, Technical Manager of the Measurement Technology Center (MTC) at JPL, needed to come up with a data acquisition system to support this experiment.

Solution: Dr. Baroth turned to Macintosh® technology along with a Macintosh-based graphical programming software called LabVIEW by National Instruments for a data acquisition system. At the time, LabVIEW ran only on the Macintosh. The initial system was configured on a Mac IIx, and as the project progressed from being a ground experiment to a flight experiment, Baroth kept both components, moving to a Macintosh Quadra® 950 and the latest version of LabVIEW.

Though the system was initially developed for data acquisition, it soon evolved to perform a gamut of functions, including serving as a flight test characterization tool. For the Endeavour experiment, the system was used as a data display, archiving, analysis, internet and commanding tool. According to Dr. Baroth, ~~it comes as no surprise~~ ^{that the} Macintosh Quadra was able to progress through the various phases of the BETSCE project. "That's why we chose it," he says. "The Macintosh platform is a good choice for data acquisition, analysis and internet capability due to the ease and flexibility of configuration, availability of software and consistency."

Success!stories

Apple Macintosh in

Technical Markets

Summary

In May 1996, World Wide Web users had a chance to observe the live downlinking of data from an experiment aboard the space shuttle Endeavour. The experiment, called the Brilliant Eyes Ten-Kelvin Sorption Cryocooler Experiment or BETSCE, was designed by the Jet Propulsion Laboratory (JPL) of NASA to test out a new refrigeration technology. The computer system that was used for the project—from its initial testing phase to its space shuttle try-out—was a Macintosh Quadra using LabVIEW graphical programming software by National Instruments.

Key Benefits

•Based on the success of the BL TSCC project onboard the Endeavour, sorption coolers were proved to be a viable approach for aiding in experiments in space that require low temperatures and stable conditions.

•Among the proposed projects that the sorption coolers will make possible is the ability for scientists to search the solar system for earth-like planets and to more accurately test various Big Bang theories.

JUL-25-97 02:08 PM P. 54

The Macintosh was also selected because of its consistency. "A Mac[®] is a Mac[®] is a Mac[®]. All PCs are not all the same," says Baroth. "We liked the backup Apple[®] could provide. Knowing we could count on just unplugging a Macintosh Quadra 950 and replacing it with the spare 700 we bought was a reassurance factor we wanted during the experiment."

Among the functions the Macintosh/LabVIEW system performed during the Endeavour launch was the gathering of data from about 100 sensors located on the experiment, which was based in the Space Shuttle's cargo bay. These sensors tracked temperature, pressure, and voltages. This data was timed and stored as the experiment went along and appeared on the computer screen in a graphical format. Also, LabVIEW was able to convert the voltage levels to understandable numbers on the display screen.

During the Endeavour launch, the data was downloaded from the space shuttle to the NASA Johnson Space Center in Houston, which relayed the data to the Macintosh Quadra running LabVIEW at JPL's Measurement Technology Center in Pasadena, California. From there, JPL sent the data to a LabVIEW-based web server at National Instruments in Austin, Texas. The live data was available for viewing on the National Instruments' website and data could also be found on an Apple website. The National Instruments website received a half million hits over the ten days of the Endeavour flight.

Benefits: During its Endeavour try-out, the BETSCE performed close to predictions. Dr. Baroth and ~~the~~ ^{the engine} team of scientists at JPL are confident that the sorption coolers are a viable approach and can be connected to various instruments for experiments in space that require low temperatures and stable conditions.

Among the proposed projects that the sorption coolers will help benefit is allowing scientists to search the solar system for earth-like planets. This can be accomplished by connecting sorption coolers to optical detectors that use infrared technology to examine wavelengths in space.

By being able to investigate hitherto unexplored energy wavebands of space with optical detectors attached to sorption coolers, astrophysicists around the world are expected to work on a collaborative project to test different models of how the universe was formed (Big Bang theory).

Pull Quote

"The Macintosh platform is a good choice for data acquisition, analysis and Internet capability due to the ease and flexibility of configuration, availability of software and consistency."

—Dr. Edmund Baroth, Technical Manager, Measurement Technology Center, Jet Propulsion Laboratory

Systems at-a-Glance

*Apple Hardware / Software:
Macintosh Quadra 950
Macintosh Quadra 710*

the engineers

*Third-Party Hardware / Software:
National Instruments LabVIEW
Microsoft Excel
Microsoft Word*

Networking:

Success!stories

FINAL AGREEMENT Success!story AUTHORIZATION

I hereby agree [o the following level of authorization regarding the use of my completed Success!story:


1. Level One Authorization - Internal

2, Level Two Authorization **.Limited** External, General Use

I understand that if my Success !story testimonial is selected for possible placement in any type of print media or broadcast, I will be renotified for a review of its usage and respective authorization.

I have reviewed the story, in its final form, and provide Apple Computer, Inc. with this final, signed-off authorization to use the story.

Signature Mary Sue O'Brien Date 8/6/97
Name MARY SUE O'BRIEN title COPYRIGHT ADMINISTRATOR
Company Jet Propulsion Laboratory

 Apple Computer, Inc.

Success!stories

CgI

get the fax..... 2 pages.....

to: Mary Sue O'Brien, JPL
 fax: 818/354-2842 [ph. 818/354-5070]
 fr: Bryan Doolley, C.G.I.
 fax: 408/464-4313 [ph. 408/464-4300]
 re: Success!story

cc: mtdh:

Thanks Mary Sue, for
 making the authorization process
 through Document Review
 - Bryan

 Apple Computer, Inc.